


The colorectal surgeon's personality may influence the rectal anastomotic decision

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Abstract

Aim Colorectal surgeons regularly make the decision to anastomose, defunction or form an end colostomy when performing rectal surgery. This study aimed to define personality traits of colorectal surgeons and explore any influence of such traits on the decision to perform a rectal anastomosis.

Method Fifty attendees of The Association of Coloproctology of Great Britain and Ireland 2016 Conference participated. After written consent, all underwent personality testing: alexithymia (inability to understand emotions), type of thinking process (intuitive versus rational) and personality traits (extraversion, agreeableness, openness, emotional stability, conscientiousness). Questions were answered regarding anastomotic decisions in various clinical scenarios and results analysed to reveal any influence of the surgeon's personality on anastomotic decision.

Results Participants were: male (86%), consultants (84%) and based in England (68%). Alexithymia was low (4%) with 81% displaying intuitive thinking (reflex, fast). Participants scored higher in emotional stability (ability to remain calm) and conscientiousness (organized,

methodical) compared with population norms. Personality traits influenced the next anastomotic decision if: surgeons had recently received criticism at a departmental audit meeting; were operating with an anaesthetist that was not their regular one; or there had been no anastomotic leaks in their patients for over 1 year.

Conclusion Colorectal surgeons have speciality relevant personalities that potentially influence the important decision to anastomose and could explain the variation in surgical practice across the UK. Future work should explore these findings in other countries and any link of personality traits to patient-related outcomes.

Keywords Rectal anastomosis, surgeon personality, decision-making

What does this paper add to the literature?

The personality of the colorectal surgeon has not been documented before. Traits that are favourable to such a specialty – intuitive thinking, conscientiousness, openness and the ability to understand emotions – have been found. In addition, some personality traits appear to influence the individual surgeon's operative decision-making.

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Initial findings were presented, but not published, as an invited presentation to the Association of Coloproctology of Great Britain and Ireland, Bournemouth, UK, July 2017 (not published).

Introduction

In colorectal surgery, rectal anastomotic leakage is the single greatest risk factor for perioperative mortality leading to poorer long-term oncological outcomes and quality of life [1–4]. Surgeons must take an individual patient-centred approach when deciding the best option: primary anastomosis alone; primary anastomosis with defunctioning loop ileostomy (protect the

anastomosis and reduce the need for reoperation); or permanent end colostomy (usually for poorly functioning or high-risk patients) [5–8]. However, anastomotic practice across the UK varies despite the likelihood that surgeons with similar levels of experience are operating on similar patients with similar intra-operative factors [9].

Heuristics in surgery is a growing academic area striving to identify biases, particularly situational factors and personality traits that are unrelated to patient characteristics. Such insights are desirable to ensure that predictable flaws or biases are identified, acknowledged and subsequently modified to prevent flawed decision-making and improve outcomes; the published work on heuristics in prevention of major bile duct injury during cholecystectomy is an example [10–12].

In the first work to explore the heuristics of rectal anastomosis, a survey of the Colorectal Surgical Society of Australia and New Zealand (75% response rate) suggested that older surgeons and those more likely to take risks in their personal life were less likely to form stomas in patients undergoing resection for rectal cancer [13]. The authors highlighted that the impact of surgeon age on stoma formation was converse to risk-taking behaviour in the general population, which declines with age [14]. The same group confirmed these findings in UK colorectal surgeons (lower survey response rate of 19%), additionally reporting that surgeons who believed that they had a lower than average anastomotic leak rate were also less likely to choose stoma formation [15].

To advance understanding of the heuristics of rectal anastomosis we performed a Delphi exercise with three aims: to describe personality traits of colorectal surgeons; to describe anastomotic decisions by individual surgeons in different anastomotic scenarios to confirm variation in practice; and to explore the influence of personality traits on anastomotic decisions.

Method

The Edinburgh Delphi (when to avoid or DefunctIoN a rectal anastomosis: what Behaviours and situational factors Underlie the decision-making pathway) was developed with the support of the Association of Coloproctology of Great Britain and Ireland (ACPGBI) and executed at their annual meeting (4 July 2016, in Edinburgh, Scotland, UK) [16]. ACPGBI initiatives involving clinical and patient groups had previously highlighted anastomotic decision-making in rectal surgery as a key research area [17,18].

The design was based on the modified Delphi method that can be used to achieve expert consensus

in situations where established theory or evidence does not create an absolute answer [19]. A steering group consisting of a health research psychologist, two patient representatives, colorectal trainees and consultants designed and executed the meeting which comprised two rounds: Round 1, psychological and personality questionnaires followed by case presentations; Round 2, clinical scenarios with interactive Delphi facilitated by a panel of steering group members and real-time voting.

Participants

The total of 50 participants was pragmatically selected to allow every participant the opportunity to express his or her viewpoint in the interactive discussion sections. For inclusion, participants had to be making regular independent rectal anastomotic decisions: postfellowship exam surgical trainees (i.e. speciality trainee level 7/8); post-CCT fellows (completion of Certification of Training); staff grades and consultants. An open invitation was made for volunteers via ACPGBI mailing lists and social media with the information that the Edinburgh Delphi was investigating factors influencing the anastomotic decision and that completion of psychological and personality questionnaires was required. Ethical approval was obtained from the School of Psychology Ethics Committee, University of Nottingham (reference number 849; 13 June 2016) and each participant completed a written consent form.

Round 1: psychological and personality questionnaires

Demographics, institutional details and surgical experience were recorded and each participant completed the following questionnaires: Toronto Alexithymia Scale [20–22], Cognitive Reflection Test (CRT) [23] and the Ten-Item Personality Inventory (TIPI) [24] (Appendices S2–S4 in the online Supporting Information). Each participant had 3 min to complete each questionnaire in silence and without interpersonal interaction.

Alexithymia

Alexithymia is the inability of an individual to identify and describe feelings both in themselves and others. The validated Toronto Alexithymia Scale (TAS-20) consists of 20 items with participants rating their affinity for each characteristic item on a five-point Likert-scale (1 = completely disagree, 5 = completely agree) resulting in a score ranging from 20 to 100 [20–22,25–27]. Using predetermined cut-offs, an individual is considered to have high alexithymia if the TAS-20 score is 61 or greater, borderline if 52–60 and not present if 51 or less.

Cognitive Reflection Test

The CRT is a three-question test that measures the ability of the participant to switch from system 1 thinking (intuitive, type 1 thinker) to system 2 thinking (rational, analytical, type 2 thinker) [23]. Each of the three questions had a correct analytical answer and an incorrect intuitive answer and all had to be completed within 3 min. Each correctly answered question scored one point, resulting in a range of scores from 0 to 3, with higher scores equating to a greater use of rational, analytical processing.

Personality

Personality was assessed using the validated TIPI, a short, easy to use and valid personality score. Ten pairs of adjectives assess the big five personality domains: extraversion, agreeableness, conscientiousness, emotional stability and openness to experiences [24]. For each pair, participants were asked to consider the statement 'I see my self as ...' and responded on a seven-point Likert scale (1 for strongly disagree up to 7 for strongly agree). Each adjective pair has an opposite statement where the scoring from 1 to 7 is reversed. For example, extraversion was scored from 'I see myself as enthusiastic and extraverted' with the reverse scoring for 'reserved and quiet'. The two scores for each pair were added together then divided by two to give a single score for each of the five personality groups, higher scores equating to higher levels.

Round 1: case presentations

In silence and with no interaction, each participant completed six case presentations (Table 1). With the aim of establishing a variation in anastomotic practice by the participants, all cases were designed to highlight common patient and operative situations that a colorectal surgeon may encounter when making an anastomotic decision in anterior resection. Each scenario had three possible answers: anastomosis; anastomosis with defunctioning stoma; no anastomosis with end stoma. Each participant had 2 min to individually answer each scenario anonymously via a keypad. To minimize external influence, each table completed the scenarios in a different order from other tables and the results were not displayed at any point.

Round 2: clinical scenarios and interactive Delphi

Each scenario was designed to explore situational influences on participants that did not relate to patient or intra-operative factors. In order, each of the seven scenarios was explained to the participants, followed by 'How does this influence your next decision to perform an

anastomosis?' and then all participants were invited to discuss. During each scenario discussion, participants voted at any point on a keypad using a Likert scale from 1 ('not at all likely') to 10 ('very likely'). If the keypad was pressed more than once it would register the last input, allowing participants to change their answer during the room discussion. The voting was displayed in real time on the room monitors to allow participants to be influenced by consensus. Each question closed with a 5-s countdown.

Statistical analysis

Descriptive analysis was performed to summarize participants' demographics and surgical experience. For the cases in Round 1, if 75% or more of participants agreed on one answer, the steering group defined this as a consensus, a level defined from a recent systematic review [28]. In Round 2, scenarios were explored for the influence of the psychological and personality profiling on the next decision to anastomose using Spearman's rho and comparison across decision-making scenarios using repeated measure ANOVAs. One-sample *t*-tests were used to compare the surgeons' means on personality variables compared with normative data. All tests were two-tailed and performed using SPSS Statistics for Windows (IBM Corp. Released 2013, Version 24.0. Armonk, New York, USA).

Results

The demographics and surgical experience of the 50 participants are displayed in Table 2.

Round 1: psychological and personality questionnaires

Alexithymia

The surgeons scored 43.08 (SD = 8.57) on average. Application of the cut-offs, resulted in: 82% no alexithymia ($n = 41$); borderline 12% ($n = 6$) and 4% high alexithymia ($n = 2$).

CRT

The mean score was 0.80 (SD = 0.78). Overall scores were: 0, 40% (completely intuitive); 1, 41%; 2, 16% and 3, 2% (completely rational). Table 3 shows other populations for comparison.

TIPI

Surgeons displayed a range of personality traits (Table 4). On comparison with population norms, using one-sample *t*-tests with the normative value for each trait, surgeons scored similarly on extraversion, agreeableness and openness, but were significantly

Table 1 Round 1 of the Edinburgh Delphi: case presentations.

| Case no. | Case description |
|----------|--|
| 1 | An 85-year-old woman has a confirmed mid rectal cancer (T3a N0) on MRI. She has a past medical history of ischaemic heart disease, coronary stent insertion 7 years ago and osteoarthritis affecting her hands. She is supported by her family in wishing to have surgical resection but has expressed a wish not to have a stoma. She is concerned that a stoma will have a severe impact on her independence, which is important to her |
| 2 | A 31-year-old woman with learning disabilities undergoes an emergency laparotomy for recurrent sigmoid volvulus that could not be decompressed endoscopically. She was judged as lacking the capacity to consent and treatment was initiated in her best interests with the agreement of a colleague and next of kin. There is minimal physiological compromise and the bowel appears healthy, albeit chronically dilated. The patient's family and carers expressed concern preoperatively that a stoma would lead to significant behavioural problems and greater dependence |
| 3 | An obese 64-year-old male undergoes an emergency distal sigmoid resection for suspected perforated cancer within a diverticular segment with a localized abscess present. Ligation of the inferior mesenteric artery is undertaken at origin, given the concern about malignancy. The abdominal wall adiposity is such that full splenic flexure mobilization is required to deliver a stoma to the skin surface. His only other comorbidities are hypertension and gout. |
| 4 | A 49-year-old man has undergone long-course chemo-radiotherapy for a rectal tumour residing 8 cm from the anal verge with a threatened circumferential resection margin. He is otherwise fit and well. He works as a manual labourer on sites with restricted toilet facilities and is concerned about the social stigma of a stoma among fellow workers. He also has limited sick leave. The operation is generally 'oozy' and total blood loss is 700 ml. |
| 5 | An elective resection for chronic diverticular disease in a 53-year-old woman is planned. At operation, the sigmoid colon is thickened and adherent to the bladder, with a loop stuck on to the upper rectum in the pelvis. Following a difficult mobilization, the offending segment is resected, with the distal resection margin at the upper rectum, below the pelvic brim. The remaining rectum seems mildly thickened but this is thought to be reactive. There is no evidence of a fistula into the bladder on pressure testing or on preoperative imaging. |
| 6 | A 61 year-old healthy woman with a screen-detected upper rectal cancer is undergoing elective anterior resection. The total mesorectal excision is relatively uneventful. You carry out the highest number of rectal cancer resections in your department with acceptable morbidity and mortality rates over the past few years. By chance, two patients under your care with anastomotic leaks were discussed at last week's audit meeting. One patient had been salvaged during a protracted hospital stay and the other had been defunctioned but had required drainage of a pelvic abscess. Consultant outcome publication is due to be published in a fortnight and you are already aware that your mortality is the highest in your department, and higher than the national average, although within confidence intervals. The procedure is uneventful but the anastomosis will be low. |

higher on conscientiousness and emotional stability (6.1, $t_{\text{one-sample}(49)} 5.55$, $P < 0.001$ and 5.4, $t_{\text{one-sample}(49)} 3.48$, $P = 0.001$, respectively).

Correlation between psychological and personality profiling found that those high in openness (open to new experiences, creative) were less likely to be rational, system 2 thinkers on the CRT ($\rho = -0.42$, $P = 0.002$) and those who scored higher in alexithymia were likely to be less agreeable (sympathetic, warm) ($\rho = -0.49$, $P = 0.001$).

Round 1: case presentations

Consensus was achieved in cases 1, 2 and 4 with participants giving consideration to the patient's wishes, but ultimately choosing the safest option for each patient (Table 5).

Consensus was not reached in cases 3, 5 and 6, primarily because many clinical variables were presented

creating room for differential weighing of factors by different surgeons. However, there were themes that may be drawn. In case 3, with variables including emergency procedure, localized abscess, high vessel ligation and obesity, few colorectal surgeons would consider a primary anastomosis alone, with 80% of participants creating a stoma. Case 5 is a comparable elective equivalent of case 3, with just intra-operative details provided. Here, few surgeons would perform an end-colostomy (4%). The last case focused completely on the influence of the surgeon with few patient details provided. The influence of previous anastomotic leaks almost equally divided the participants, between primary anastomosis alone and anastomosis with defunctioning ileostomy.

Round 2: clinical scenarios and interactive Delphi

A range of answers was given for each scenario, except in scenarios 5 and 7 (Figs. 1–7). To explore the

Table 2 Demographics and years of experience as surgeon of The Edinburgh Delphi participants.

| | Number | % |
|--|--------|----|
| Age (years) | | |
| <35 | 2 | 4 |
| 35–39.9 | 7 | 14 |
| 40–49.9 | 21 | 42 |
| 50–59.9 | 16 | 32 |
| ≥60 | 4 | 8 |
| Gender | | |
| Male | 43 | 86 |
| Female | 7 | 14 |
| Status | | |
| Specialist registrar/ST | 4 | 8 |
| Associate specialist | 3 | 6 |
| Post-CCT fellow | 1 | 2 |
| Consultant | 42 | 84 |
| Years of experience as consultant* | | |
| 0–2 | 5 | 11 |
| >2–5 | 8 | 18 |
| >5–10 | 8 | 18 |
| >10–20 | 15 | 34 |
| >20 | 8 | 18 |
| Place of work | | |
| Scotland | 4 | 8 |
| England | 34 | 68 |
| Ireland | 3 | 6 |
| Wales | 3 | 6 |
| Other European country | 0 | 0 |
| Outside Europe | 6 | 12 |
| Number of consultant colorectal colleagues in your department† | | |
| 1–3 | 5 | 10 |
| 4–6 | 26 | 54 |
| 7–10 | 14 | 29 |
| >11 | 3 | 7 |

*Percentages expressed from a total ($n = 44$) as two associate specialists responded.

†Percentages expressed as a total ($n = 48$) as there were two nonresponders.

findings, a one-way repeated measures ANOVA on scenario values, with Greenhouse–Geisser correction, revealed a significant effect for scenario ($F_{(4.2, 194.8)} 21.1, P = 0.000, \epsilon^2 P = 0.75$) representing a strong linear trend ($F_{(1, 46)} 114.0, P = 0.000, \epsilon^2 P = 0.71$). The trend across scenarios is shown in Fig. 8 with the likelihood of the next anastomotic decision being significantly less influenced by scenario 5 (high-risk patient who you will personally review every day) and scenario 7 (patient or their partner is a medical malpractice solicitor) compared with scenarios 1, 2 and 3 which were greatly influenced (no anastomotic leak for over a year;

Table 3 Cognitive Reflections Test: intuitive versus rational thinking in surgeons and other populations.

| Institution/study | Mean | N |
|---|------|------|
| Massachusetts Institute of Technology (MIT) | 2.18 | 61 |
| Princeton University | 1.63 | 121 |
| Carnegie Mellon University | 1.51 | 746 |
| Harvard University | 1.43 | 51 |
| University of Michigan: Ann Arbor | 1.18 | 1267 |
| Bowling Green University | 0.87 | 52 |
| University of Michigan: Dearborn | 0.83 | 154 |
| Edinburgh DELPHI | 0.80 | 50 |
| Michigan State University | 0.79 | 118 |
| University of Toledo | 0.57 | 138 |

0, completely intuitive; 3, completely rational.

Table adapted from Table 1 in ‘Cognitive reflection and decision-making’, Fredrick S, *J. Econ. Perspect.* 2005; 19: 25–42.

recent criticism of an anastomotic leak at departmental audit meeting; and recent death of a patient who had an anastomotic leak, respectively).

In relation to personality, there were significant associations between personality and the surgeons’ self-reported decision to anastomose or not. For scenario 1 (no anastomotic leak for over a year) those surgeons who scored high in openness were more likely to say they would be influenced in their decision ($\rho = 0.30, P = 0.039$). For scenario 3 (recent criticism of an anastomotic leak at departmental audit meeting) those participants high in conscientiousness were less likely to say this was an influence on the decision about their next anastomosis ($\rho = -0.44, P = 0.0003$). For scenario 6 (operating with an anaesthetist who is not your regular one) those high in alexithymia ($\rho = 0.30, P = 0.041$), those with a more rational thinking style ($\rho = 0.32, P = 0.025$) and those lower on openness ($\rho = -0.31, P = 0.028$) were more likely to state their next anastomotic decision would be influenced.

Discussion

This is the first study to explore the influence of personality on the heuristics of colorectal surgeons. Surgeons reported traits that appear favourable to their chosen speciality: thinking processes that are predominately intuitive, low levels of alexithymia and high levels of conscientiousness and emotional stability. Consensus in the decision to anastomose in rectal surgery was evident in some case presentations and clinical scenarios, but not in those with increasing complexity. When this variation in practice was explored, the personality of the individual surgeon was found to be a potentially influencing factor.

Table 4 Comparison of participating surgeons' personality traits versus norms.

| | Gosling <i>et al.</i> 's norms* | Surgeons (SD) | One sample <i>t</i> -test |
|---------------------|---------------------------------|---------------|-----------------------------|
| Extraversion | 4.4 | 4.6 (1.7) | $t_{(49)} 1.13, P = 0.262$ |
| Agreeableness | 5.2 | 4.9 (1.3) | $t_{(49)} -1.43, P = 0.159$ |
| Conscientiousness | 5.4 | 6.1 (0.9) | $t_{(49)} 5.55, P = 0.000$ |
| Emotional Stability | 4.8 | 5.4 (1.3) | $t_{(49)} 3.48, P = 0.001$ |
| Openness | 5.4 | 5.4 (1.1) | $t_{(49)} -0.18, P = 0.852$ |

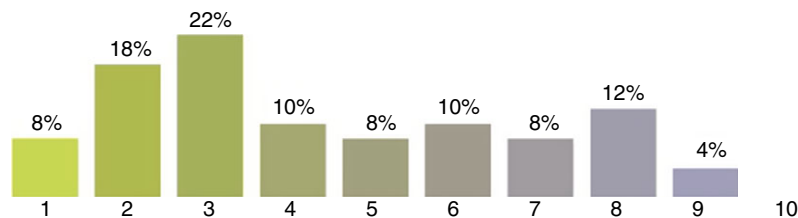
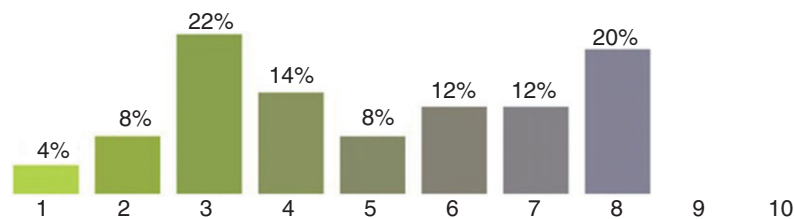
*Gosling SD, Rentfrow PJ, Swann WB. A very brief measure of the Big-Five personality domains. *J. Res. Pers.* 2003; 37: 504–528.

Table 5 Case presentation decisions from Round 1 of The Edinburgh Delphi.

| | Primary anastomosis | Defunctioning loop ileostomy | End colostomy | Consensus (yes/no) |
|--------|---------------------|------------------------------|---------------|--------------------|
| Case 1 | 3 (6%) | 39 (78%) | 8 (16%) | Yes |
| Case 2 | 41 (82%) | 7 (14%) | 1 (2%) | Yes |
| Case 3 | 9 (18%) | 13 (26%) | 27 (54%) | No |
| Case 4 | 1 (2%) | 42 (84%) | 2 (4%) | Yes |
| Case 5 | 29 (58%) | 16 (32%) | 2 (4%) | No |
| Case 6 | 28 (56%) | 21 (42%) | 0 (0%) | No |

Shaded boxes denote where a consensus was reached ($\geq 75\%$).

Where participants have not responded the percentage is still calculated from $n = 50$.

**Figure 1** Response from Delphi participants on the following clinical scenario that may influence the next decision to perform a rectal anastomosis: you haven't had an anastomotic leak for over a year (and you have been busy) [answers scored from 1 ('not at all likely') to 10 ('very likely')].**Figure 2** Response from Delphi participants on the following clinical scenario that may influence the next decision to perform a rectal anastomosis: recent death of a patient that leaked following a primary anastomosis [answers scored from 1 ('not at all likely') to 10 ('very likely')].

Almost all surgeons were completely intuitive in their thinking style, which could be potentially favourable in their day-to-day working environment, where quick, multiple and important decisions are made on ward rounds, outpatient clinics and theatre

operating rooms. Indeed, undergraduate medical school teaching may encourage such thinking processes; previous reported work on 128 medical students who completed the CRT found that, compared with senior medical students, preclinical students

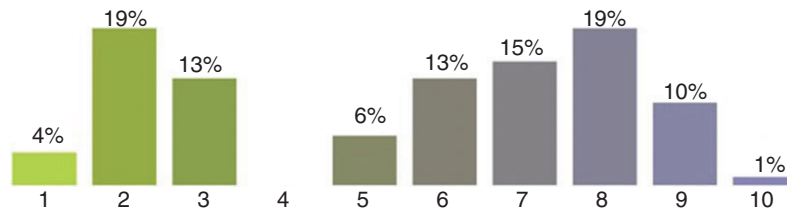


Figure 3 Response from Delphi participants on the following clinical scenario that may influence the next decision to perform a rectal anastomosis: recent criticism at a departmental audit meeting for performing an anastomosis that leaked [answers scored from 1 ('not at all likely') to 10 ('very likely')].

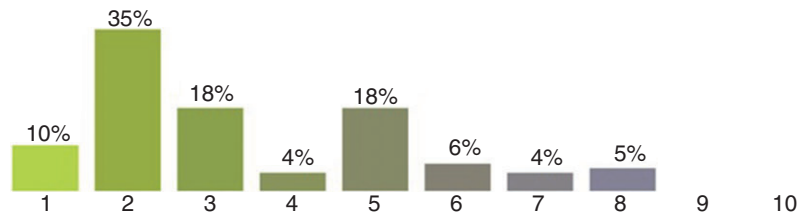


Figure 4 Response from Delphi participants on the following clinical scenario that may influence the next decision to perform a rectal anastomosis: your close colleague has recently been heavily criticized for performing an anastomosis in a patient who died and has discussed the case with you at length [answers scored from 1 ('not at all likely') to 10 ('very likely')].

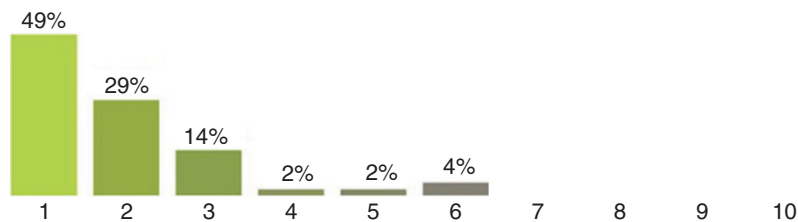


Figure 5 Response from Delphi participants on the following clinical scenario that may influence the next decision to perform a rectal anastomosis: you have a high-risk patient that you are going to operate on. There is a large association meeting that many of your colleagues are going to. You are *not* going on study leave, or annual leave and you will be covering the unit over the weekend so will personally review them every day for the next 7 days [answers scored from 1 ('not at all likely') to 10 ('very likely')].

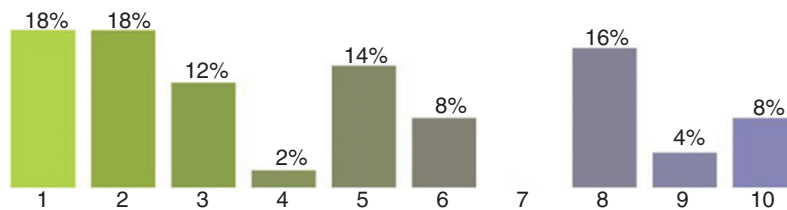


Figure 6 Response from Delphi participants on the following clinical scenario that may influence the next decision to perform a rectal anastomosis: the last two cases you did with this particular anaesthetist (not your regular one) died of complications of an anastomotic leak and you are operating with them again [answers scored from 1 ('not at all likely') to 10 ('very likely')].

displayed higher levels of slow, rational type 2 thinking [29].

The higher levels of conscientiousness and emotional stability reported in this group of surgeons alongside low alexithymia challenge the perceived 'surgical personality' stereotype of arrogance, impatience,

extraversion and being unfriendly and distant [30]. This stereotype was also challenged in a recently published personality survey on nearly 600 surgeons of all specialties [31]. High levels of conscientiousness and emotional stability would appear to be desirable traits in colorectal surgeons, with the former being associated

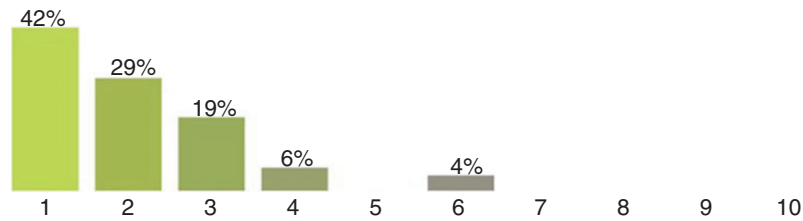


Figure 7 Response from Delphi participants on the following clinical scenario that may influence the next decision to perform a rectal anastomosis: the patient or their partner is a medical malpractice solicitor [answers scored from 1 ('not at all likely') to 10 ('very likely')].

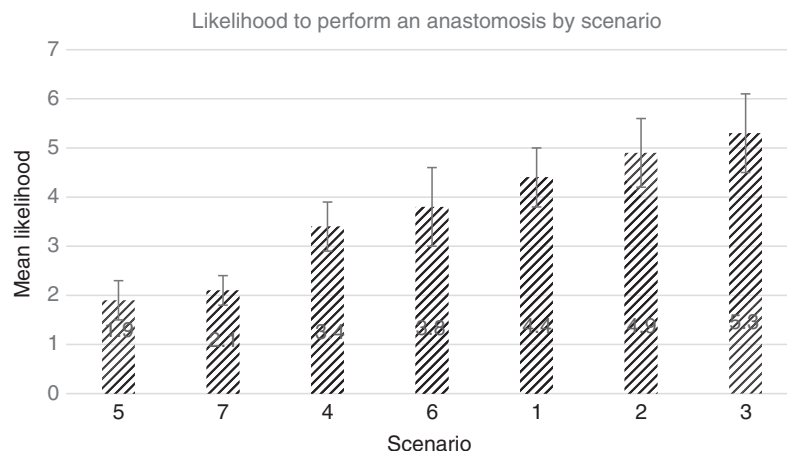


Figure 8 Comparison of the likelihood of each clinical scenario influencing the next decision to perform a rectal anastomosis (error bars = 95% CIs; values in the bar = the mean values).

with academic achievement, precision, organizational skills and efficiency whilst the latter reflects the individual's ability to remain calm under pressure and not display extremes of emotion that is commonly associated with being a leader [32,33]. In addition, the low levels of alexithymia reported in this group of colorectal surgeons compare favourably with higher levels reported in two large European population studies (4% *vs* 10% and 13%), which is clinically relevant as empathy has been shown to correlate with improved patient compliance and satisfaction [34–37].

The decision to anastomose or not in rectal surgery is multifactorial with no 'right' answer for all patients, which is reflected in this study where agreement was found in just half of the case presentations, with increasing case complexity producing greater variation in responses. With 88% of participants working in the UK, these results support the variation in anastomotic practice that is known to exist in the UK [9]. To further analyse this variation in practice, the clinical scenarios were developed to explore the response of individual surgeons to commonly encountered situations. Being the only surgeon in the unit whilst colleagues are away or operating on a medical malpractice solicitor or his or

her relative were strongly reported as not influencing the next anastomotic decision. However, the remaining scenarios did influence the next anastomotic decision, including and perhaps reassuringly, a recent fatal anastomotic leak and recent criticism at one's unit departmental audit meeting about a leaked anastomosis.

In relation to the influence of personality, three scenarios appeared to be influenced. In the first the surgeon was working with a relatively unknown and untested anaesthetist where the last two patients had died of an anastomotic leak. There was no comment on the competency of the anaesthetist in this question, allowing focus on the surgeon's interpretation of why the anastomotic leaks had occurred. If the surgeon's personality was high in alexithymia, high in slow, rational process thinking or less open then their anastomotic decision was likely to be influenced in this scenario. Interestingly, these three influencing personality traits share a lesser or slower ability to learn from mistakes or losses [38].

In the second scenario, surgeons high in openness were more likely to let a recent good spell of no anastomotic leaks for over a year influence their next anastomotic decision. Openness is associated with engaging

with new ideas, intellectual curiosity and, as a result, nontraditional ideas including superstition [39]. Many of the participating surgeons will know their individual yearly anastomotic leak rate from national audits [9] so logically this statistic should not influence individual cases, but these results tentatively suggest that it does, perhaps as a result of the individual surgeon's personality.

The last scenario to be influenced was where the surgeon had received recent criticism at his or her unit departmental audit meeting about a leaked anastomosis. Overall colorectal surgeons reported this scenario as influencing their next anastomotic decision, but greater influence was reported in those with higher levels of conscientiousness, perhaps reflecting that these surgeons value their colleagues' opinions and are more prepared to listen and reflect to improve their performance.

These early results suggest that the surgeon's personality influences the heuristics of rectal anastomosis beyond the established patient and operative factors, but with only a small sample size definitive conclusions are limited. However, if future work with larger number of participants supports these findings, then the next step would be to link heuristics and personality to individual surgeons' outcomes, such as: number of rectal cancer cases a year, stoma formation (and type) rate and anastomotic leak rate. The identification of such traits may provide an opportunity to develop personality/behaviour-modifying interventions to minimize variation in practice, especially as recent work in personality theory has found that traits are not fixed, but instead change throughout an individual's life. This can be in response to one's environment (work, university, personal life), training (including surgical programmes) and/or targeted therapeutic and psychological interventions [40–46]. It is important to highlight that any of these therapeutic or psychological interventions would not seek to remove a personality trait but modify it instead as there is no such thing as a 'good' or 'bad' personality trait as within each one there exists a 'bright-side' and a 'dark-side' depending on the demands of the situation or context [44]. As an example, anxiety (emotional stability) at high levels is a beneficial response to immediate danger, but these same levels also impede optimal physical performance as widely accepted and addressed by sport psychologists (the inverted-U hypothesis) [45].

An alternative strategy could be the development of 'matched' operators where two surgeons with differing personalities are teamed up to provide optimal heuristics. This matching could be started preoperatively, increasing the patient's opportunity for shared decision-making, and intra-operatively to maximize the

attainment of the optimal outcome as defined by each individual patient. For example some patients may wish to avoid a defunctioning stoma whilst others may wish to avoid long-term functional control problems and request a permanent end-colostomy.

The steering group acknowledge the limitations of this work. First, this work represents a self-reporting theoretical exercise where surgeons may be reluctant to comment openly or anonymously (via voting) for fear of criticism and/or they may lack insight into a discrepancy between what they think they do surgically and what they actually do. This could be explored by linking personality and heuristics to the outcomes for each individual surgeon. Second, it is possible that the results may not be generalizable to all UK colorectal surgeons as only a small pool of UK surgeons participated and as they volunteered, selection bias cannot be excluded.

Conclusion

Consensus on when to anastomose, defunction or form an end-colostomy in rectal surgery can be difficult to achieve, especially in complex cases. Colorectal surgeons have speciality-relevant personality traits, and when a consensus is not achieved variations in these traits may have an influence on the anastomotic decision, potentially explaining the variation in anastomotic practice across the UK.

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Contributions

Delphi ethics and questionnaires: EF, JT, CM-A; Delphi conception and design: NSF, JT, NH, SJM, DH; Delphi execution/data collection: SJM, NH, JT, CNB, DH, AGA, CM-A, NSF, all collaborators; Delphi participation: all collaborators; data analysis: EF, SJM, EMacD, CNB; paper drafting and editing: SJM, NH, CNB, EMacD, EF, JT, DH, CM-A, NSF, all collaborators; review of final draft: all collaborators.

Competing interest

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: financial support from the Bowel Disease

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The lead author (the manuscript's guarantor) affirms that this manuscript is an honest, accurate and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Data sharing

No patients were used in this study; presented data are anonymized and risk of participant identification low.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Edinburgh Delphi Collaborative Group members.

Appendix S2. Toronto alexithymia scale (TAS-20).

Appendix S3. Cognitive reflection test and scores, by location.

Appendix S4. Ten point personality inventory (gosling big five).